OTS: 60-11,406

JPRS: 2389

22 March 1960

AUTOMATIC CONTROL PANEL FOR A SOUNDPROOF ROOM

- USSR -

by Yu. G. Kratin and B. Yu. Yuganson

Distributed by:

OFFICE OF TECHNICAL SERVICES
U. S. DEPARTMENT OF COMMERCE
WASHINGTON 25, D. C.
~~Price: $0.50~~

U. S. JOINT PUBLICATIONS RESEARCH SERVICE
205 EAST 42nd STREET, SUITE 300
NEW YORK 17, N. Y.

JPRS: 2389

CSO: 3474-N

AUTOMATIC CONTROL PANEL FOR A SOUNDPROOF ROOM

/This is a translation of an article written by Yu. G. Kratin and B. Yu. Yuganson in Zhurnal Vysshey Nervnoy Deyatel'nosti imeni I. P. Pavlov (Journal of Higher Nervous Activity imeni I. P. Pavlov), Vol II, No 6, Moscow, 1959, pages 841-947./

Modern physiological experimental techniques require exact dosage of the stimulant, with respect to quantity and duration of time. Meanwhile, inclusion of the stimulant by hand is still a widely applied practice in the conducting of experiments, according to the cnditioned reflex method. This mode of inclusion inevitably leads to errors due to the experimentor's inaccuracy of performance, which is often unnoticed or disregarded. If such errors can be tolerated to a certain degree in cases where relatively slow reactions are registered, such as, for example, at the secretion of saliva, whose initial moment is defined in seconds, then in the case of electro-physiological investigations, where readings of hundredths or thousandths of a second are required, inclusion of the stimulant by hand is likely to produce inadmissible errors.

In order to secure an objective process of the electro-physiological experiment, not only during the recording of the reaction, but also at the introduction of the stimulant, we designed an automatic control panel, which has been successfully in operation for more than three years.

The control panel is based on the electromechanical principle of operation, which utilizes a number of electromagentic relays of various types. The automat makes

* The design and construction specification for the control panel was prepared by one of the authors of this article (Yu. G. Kratin), who also participated in the design and mounting of certain circuits. The general design of the control panel was developed by another author of this article (B. Yu. Yuganson), who, together with N. S. Trukhin, performed the assembly and final regulation of the entire system. N. D. Eismont and V. V. Artemev also participated in this project.

it possible to introduce four stimulants. Under strict control, simultaneously or successively, in any desired combination, whereby the duration of each stimulant can be varied by the experimenter within the range of 0.1 to 26 seconds. Rhythmic inclusion of the stimulants during the course of the entire experiment has been foreseen.

The general view of the oscillographic setting with automatic control panel is shown in Figure 1. A wiring diagram of the panel is presented in Figure 2.

When viewed from the outside, (below the round opening for the dynamic loudspeaker), four rows of button switches, corresponding to the number of channels to which stimulants can be applied simultaneously, are visible in the center of the panel (Figure 1). Each row contains 26 push buttons (Kh). These push buttons serve for selecting the duration of the stimulants and distribution of the stimulant combinations in time. They are connected with four rows of plates of the stepping relay (26 plates in each row), which is mounted at the left side of the panel. The lower, fifth row of push buttons serves for selecting of break /interval/ durations, and this row is connected with the right hand stepping relay. An oblong strip with eight jacks for the connection of eight supply sources for the stimulant devices is mounted at the left edge of the panel This is the point of entry /input/ of the panel (Bx). Here the tone generator (one or several) -- power supply for the electric lamps and other A. C. or D. C. voltage sources which will be cut off by the automatic control system of the panel -- can be hooked up. This will ensure prompt cutting in or cutting out of the sound, light, electro-skin stimulant contacts or any other stimulant devices.

Six knob switches are seen to the right of the strip with the input jacks. The four upper knob switches (Pr) serve for switching of the stimulants; they are applied to the input of the panel, to one of the four channels of the panel corresponding to the given knob. The two lower knobs determine the step duration of the stepping relays (the right-hand one -- the right relay, Pu1; the left-hand one -- the left relay, Pu2) and, by the same token, the multiplying factor of each knob in the channels of the panel. This factor may amount to 0.1, 0.2, 0.5 and 1.0 seconds. In this way, if we switch on, in any row, five knobs in succession at the setting of the appropriate knob on the 0.1 second division, the duration of the stimulant will amount to 0.1 x 5 = 0.5 seconds. If we press push buttons 1-2-3-4-5 and push buttons 16-17-18-19, for example, mounted in the same row but in two different places, then the stimu-

lant, say the sound, will be applied twice during one step [run] of the stepping relay: the first time for 0.5 seconds, and again after one second (10 push buttons were left out) for 0.4 seconds (4 x 0.1).

Let us assume that we must produce a combination consisting of three stimulants distributed in the following manner: duration of sound -- 2.5 seconds, light -- 3 seconds, whereby the light is to cut in after a two second isolated sound performance, and the electro-skin stimulant of one-second duration -- two seconds after the inclusion of the light. For this purpose, we first distribute our stimulants among the channels, that is, we set knob Pr1 of the first channel in the sound position, knob Pr2 of the second channel in the light position, and knob Pr3 of the third channel in the electro-skin position. As the next step we set knob Pu1 for the relay's step duration on the 0.5-second scale division, in so far as this step duration is the most suitable for the given case, and finally we have to select in a specific order the required number of push buttons in three channels. In the first row we press push buttons 1 through 5 inclusively, in the second -- from 5 to 10 inclusively (this ensures isolated performance of the sound during a period of two seconds, since push buttons 1-4 remain disengaged), and in the third row we press push buttons 25, 26 (push buttons 11, 12, 13, 14 have an integral between stimulants). At this time we switch on the panel, and this entire accurately measured off group of stimulants is applied to the chamber.

Red points go on above the pressed push buttons, and are thus distinguished from the remaining ones.

A row of double-current keys is mounted below the five push button rows. The keys Kp1 - Kp8, from left to right, serve for cutting in of the stimulants: either by hand (key position down), or automatically through the control panel (key position up). The last key in this row (ksh) engages the left (position up) or right (position down) stepping relay.

Two amplifiers for microphone-dynamic loudspeaker communication with the chamber are mounted in the upper part of the panel; the control knobs of the amplifiers can be seen to the right and left from the speaker opening. This system makes communication with the subject in the chamber possible.

Six additional knob switches are mounted at the right-hand side of the panel. One of them serves to start a small warren-type motor; the second -- to turn on the microphone-dynamic speaker system for communication with the chamber; the third one loops the circuit of the timing

device; the fourth makes it possible to connect various stimulant markings in parallel to one line; the fifth (Pp) serves for varying the operating [performance] conditions of the interval stepping relay (described below); and the sixth is a spare switch.

Leads for the stimulant markings (Shr), for recording of the experimenter's sound record, and for the subject's responses are led out at the right-hand edge of the panel. These lines pass through openings in the panel board and terminate in two-pin plugs for connection to the oscillograph (Figure 1). The microphone which transmits the experimenter's words to the chamber is mounted on the same board.

For a more detailed explanation of the control panel's operating principle let us turn to the wiring diagram (Figure 2). The point of entry to the panel is shown at the lower left angle of the diagram (only two input jacks are shown). Let us assume that a sound frequency from the audio-frequency oscillator [or tone generator] (Zg) is applied to any pair of input terminals. The diagram shows that the electric circuit, which connects the tone generator with the dynamic speaker in the chamber, is interrupted by the contacts of the magnetic relay Rz, whose closing resounds in the chamber. Other stimulant lines connected with the respective relays R1-R8 (according to the number of input jacks) operate in the same manner. The closing of the contacts R1, R2...R8 takes place upon the application of direct current to the windings of these relays. One end of the winding is connected to the common "plus," while the "minus" is applied separately to each relay through a double-current key Kr belonging to the given relay (only one such key - K1 is shown in the diagram). By pressing the key down, the "minus" is sent directly from the supply source -- in this manner the stimulant is switched on by hand. If, however, the key is set in its up position, the "Minus" is applied to one of the four channels of the automatic system through the selector switch Pr. The latter inserts the given channel into the circuit of one of the relays R1-R8 controlling the inclusion of the stimulant. In such a case the "minus" from the supply source reaches one of the poles of the push button switch. A total of 26 such poles is thus connected (see left-hand part of the wiring diagram; the push buttons are numbered 1, 2, 3,,, 25, 26). Each of the 26 other poles is connected to a corresponding plate of the stepping relay. If the push button switch is closed, the "minus" reaches the plate. If five push buttons are closed in a row, five plates will prove to be under voltage. The contact slider of the

stepping relay, which moves along all the plates (the contact slider in the diagram is shown by an arrow), removes the voltage from these plates and applies the "minus" to the winding of that stimulant inclusion relay (R1-R8), which at that moment is connected through the selector switch Pr. This relay will remain engaged for as long a time as it takes the contact slides to skim the plates under voltage, and, consequently, the stimulant will be connected for an equal length of time. In this way the duration of action of the stimulant is determined with respect to the number of engaged push buttons and the rotation speed of the contact slides of the stepping relay.

The rotation of the contact sliders Sh1 is carried out by a rathcet gearing, which is fed by direct current pulses from the interrupter. The latter consists of a row of disks with rectangular teeth, to which the "plus" is supplied from a direct current source. The disks are mounted on the shaft of a small Warren synchronous motor (My), which rotates at a speed of one revolution per minute. There are four disks: the first one has a single tooth, the second -- two teech, the third -- five, and the fourth -- ten. Contacts, which at the rotation of the disks remove from each disk a number of pulses per second corresponding to the number of teeth on the given disk, adjoin the teeth of the disks. The pulses hit the selector switch Pu1 -- and then the winding of the stepping relay via the key Ksh (the "minus" is continuously applied to the other end of the winding). Depending on the position of the selector switch Pu1, the winding receives 1, 2, 5 or 10 pulses per second, which also determines the step duration of the relay, which will be equal to 1, 0.5, 0.2 or 0,1 seconds.

The stepping relay Sh1 is statted upon the closing of the key Ksh (up position). If, however, its operation depended only on this key, it would be difficult to cut in the stimulant at the desired moment, since the switching over of the relay into the first step [initial position] by hand would not always succeed. This task is carried out with the aid of a block relay B1. In the initial position the contact slide of the stepping relay is on the 26th plate, which is connected to the block relay. The corresponding push button is always in closed position, and a current proceeds to the relay winding, since at the same instance a "plus is applied to the other end of the winding (across a 500.ohm resistor and contact slides). In this position the contacts of relay B1 are disconnected (the relay is closed in normal position). From the wiring diagram it is evident that the contacts are connected in

parallel to the key Ksh. When we close that key, the stepping relay is actuated and its contact slider jumps off the plate 26 and switches over to 1, 2, 3, etc. After this operation, the winding circuit of the stepping relay is interrupted, and the relay disengages, which brings about a closing of its contacts. At this time it does not matter whether the key Ksh is closed or open, since during the entire cycle, in the course of which the contact slider does not reach the 26th push button, the contacts of the block relay will continually close the same circuit as the key would. If the key Ksh is left closed, the stepping relay will rotate uninterruptedly. On the other hand, if, after the starting of the stepping relay, the key is opened, then the contact slider, after having reached the 26th contact, will again apply a "plus" to the winding of the block relay. The latter will be actuated and its contacts will open; the winding circuit of the stepping relay will be interruped, and the stepping relay will remain in its initial position.

The block relay is connected to the fourth channel, and, therefore, the line which links that channel with the selector switch Pr contains contacts operating from the block relay, which disconnect the line at the moment the contact slider passes the 26th contact. This exclusdes the possibility of contact between the block relay and the relays R4--R8. In other respects, all four channels are equivalent and operate synchronously, since four contact sliders move simultaneously along the four plate rows of the stepping relay. As a result, this arrangement makes it possible to determine the duration of a signal or combination of signals, either at a single instance or at any number to times desired.

Let us now turn to the right part of the diagram where the system of the stepping relay Sh2 is presented. This system ensured the inclusion of the stepping relay Sh1 at determined time intervals. The relay Sh2 is started by the same pulses emanating from the interrupter as the stepping relay Sh1. The speed of its contact sliders along the plates is also varied with the aid of a similar selector switch Pu2. It is started by the same key Ksh, but in its down position. It is provided with the same blocking system (relay B2), connected with a special row of plates (row 2) where the contact slider finds only the last -- the 26th contact -- under voltage. As a result, at an open key Ksh, the stepping relay stops in its initial position. If key Ksh remains closed, the relay operates uninterruptedly.

The second row of plates, designated by the numeral 3, has only one initial plate under voltage, to which the

"minus" is applied. The contact slider of that row is connected to the winding of the ordinary relay G1. When the stepping relay is actuated and the contact slider hits the first plate, the latter closes the winding circuit of that relay. As is evident from the diagram, the contacts of that relay operate in parallel with key Ksh of the first stepping relay, and when they close the latter is actuated and runs through a cycle engaging all the stimulants corresponding to the program determined by the push button set. Next the stopping relay Sh1 cuts out automatically and the stopping relay Sh 2 continues its operation. One more row of its plates is connected to a row of push buttons (fifth from top). Upon the closing of any push button, a "minus" from the direct current source is applied to the corresponding plate. When the contact slider reaches that plate (on the diagram that moment is shown by an arrow), it closes the circuit of the "accelerating relay" (Y). This relay is of the self-blocking type; as a result, it also remains actuated, when the contact slider jumps off the plate of the stopping relay, to which the "minus" has been applied. The blocking is insured by means of a special row of plates of the stopping relay (Row 4). A "minus" is applied to all the contacts of the relay, with the exception of the last one, the 26th contact. As soon as relay Y is actuated by the pulse passing through the contacts of the push button in row 1, it closes its own contacts (in the diagram -- the upper pair); as a result, the "minus" is applied to the fourth row of plates of the stepping relay Sh2.

At this very moment, that is, when the contact slider 1 of the plate row reaches the closed push button -- actuating as a result, relay Y -- the second pair of contacts, which is connected with relay Y (in the diagram -- the lower contacts) and inserted in the winding circuit of the stepping relay Sh2, closes. Frequent current pulses -- 10 per second -- arriving from point 0.1 sec. of selector switch Pu2 immediately begin to pass through the above contacts. These pulses emanate originally from the interrupter. As a result, from this moment on, the speed of the stepping relay Sh2 changes drastically. If, prior to that moment, it was making, for example, one step per minute, then afterwards it will operate at a speed of 10 steps per second, and the contact slider will radiply slip through the stopped contacts. By pressing one push button or another we can determine in advance the duration of the intervals between inclusions of the stepping relay Sh2 system. For example, if we press push button No 15, the stopping relay Sh2 -- being actuated -- will cut in stepping relay Sh1 on push button

No 1, the former will operate and stop, and the stepping relay Sh 2 will continue its operation -- for example, at a speed of one step per second (Pu2 on the 1-sec division). After the contact slider has reached push button No 15, relay Y begins to operate and the contact slider slips through the remaining 11 push buttons at an accelerated speed -- 10 steps per second. After that the speed of the stepping relay Sh2 will again drop to its original value, that is, one step per second, since the accelerating relay will disengage as soon as the contact slider of the fourth row reaches the last -- the 26th -- contact of that row, which is not under voltage (0 -- in the diagram). The entire cycle will repeat with the inclusion of the stepping relay Sh1 and the stimulant feed system connected to it. In this way, a rhythmic inclusion of stimulants through preset intervals in the range from 0.1 to 26 seconds can be ensured.

The stepping relay Sh2 can also operate under different operating conditions, under which, in the course of its run -- in this case at a constant step -- it can at a given moment engage the system of the stepping relay Sh1 several times. For this purpose the selector switch Pr is set in its second position. Now, upon starting the stepping relay Sh2 it will continue, as before, to engage the system of the first stepping relay at the opening of the first push button; besides this, however, it can switch on that system by any other push button -- if that push button is engaged in the system -- because at the moment the contact slider slips through the corresponding plate it will feed the "minus" to relay G2, whose operation is similar to relay G1 ("plus" is continuously applied to both relays). In this way, it is possible to insert, for example, a stimulant or a system of stimulants at the first, tenth, and 22nd seconds from a given moment, if push buttons No 10 and No 22 are pressed and the stepping relay operates at a speed of one step per second.

Experience has shown that the panel satisfactorily meets the requirements of electro-physiological experiments, especially at the recording of an electro-encephalogram at a scanning speed of three to six centimeters per second, when the inertness of the mechanical switching systems of the stimulants has not as yet made itself felt. The panel can be utilized for the conducting of various experiments on reflex behavior, with the application of classical and other methods of investigating the higher nervous activity of human beings and animals. Nevertheless, the panel has disadvantages as a result of the noise produced by the operation of the stepping relays. The noise can be easily

reduced, however, by placing these relays in a sound-absorbing housing. In the case of an adequate soundproof chamber this problem does not play any role at all.

In addition to ensuring a high degree of objectivity in the determination of the inclusion moments of stimulants and their durations, the panel also permits repid and accurate change-over in the order of application and time characteristics of the stimulants, which is frequently required in the course of the experiments. Furthermore, when several investigators, employing various systems of stimulants, use one setting, the capability of changing the experimental scheme rapidly is particularly important. All this favors the application of an automatic stimulant feed system, an exaple of which is the above-described control panel.

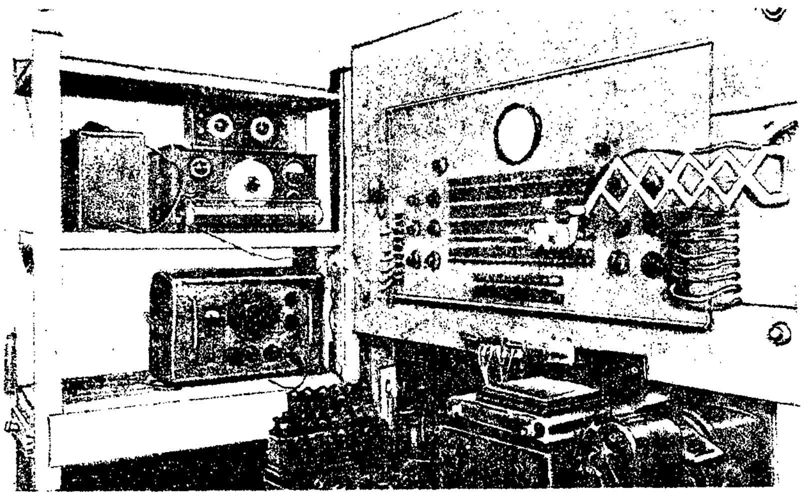

Fig. 1

Automatic control panel and general view of the apparatus. Upper right -- panel, below it -- six-loop oscillograph, at the left -- audio-frequency oscillators.

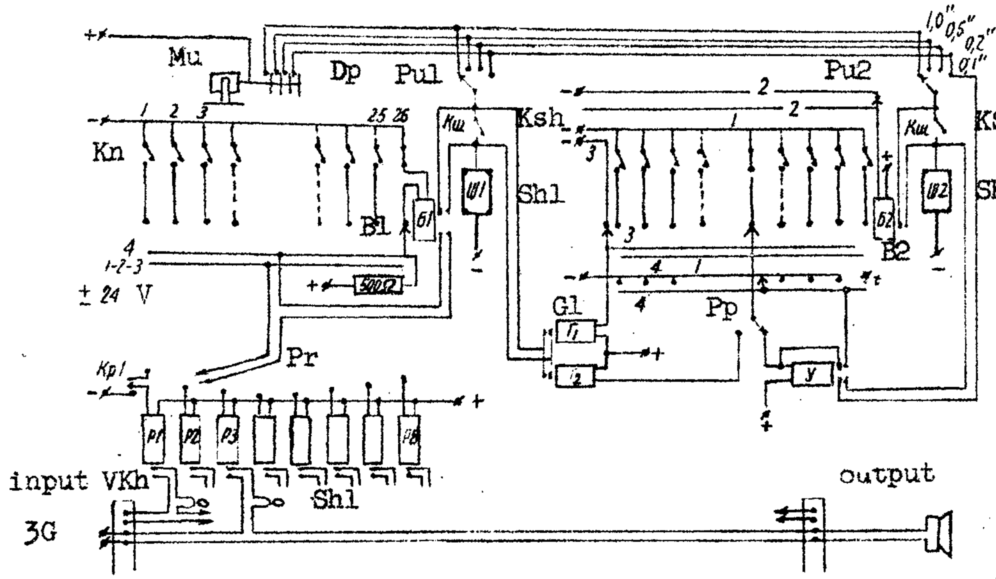

Fig. 2

Control panel working principle. B-blocking relay; Bkh, Vykh -input and output of the panel; Gi, G2-contact [or transitory] relays; Dp-interrupter disks; Zg-audio-frequency oscillator; Kn-push button; Kp-key for direct and automatic inclusion of stimulants; Ksh-stepping relay key; Mu-small Warren motor; Pu-pulse selector switch; Pp-performance change-over switch for relay Sh2; Pr-channel selector switch; P1-P8-stimulant inclusion relay; Y-accelerating relay; Shi, Sh2-first and second stepping relays; Shl-stimulant marking loop.

1291 END